SCIENCE

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THE SUPPRESSION OF CONSUMPTION.

THE first step in the practical suppression of consumption is to take those measures that are necessary to reduce its production to insignificant proportions; that is, we must secure the effective prevention of the disease. We shall attain this object by seeing that, on the one hand, we have or obtain such an amount of lung surface as is adequate not only to perform the ordinary work that is demanded of it, but also to meet, within certain limits, any extra demand that may be made upon it, and, on the other, by so arranging our habits, mode of life, and surroundings, that their tendency as a whole is to develop the lungs. What amount of lung capacity is necessary to conform to the above requirements? Hutchinson's so-called standard of vital capacity is too low. The lungs of a man having a chest-girth ranging between Brent's "medium" and "maximum" standards, with an extent of movement of four inches and upwards, would give the required amount of lung surface. I give these standards in the following table:—

Height. Ft. In.	Medium. Inches.	Maximum. Inches.
5 1	34.56	40.66
5 2	35.01	41.33
5 3	35.70	42.00
5 4	36.26	42.66
5 5	36.83	43.33
5 6	37.40	44.00
5 7	37.96	44.66
5 8	38.53	45.33
5 9	39.10	46.00
5 10	39.66	46.66
5 11	40.23	47.33
6 0	40.80	48.00

It will be found, on examination, that many of us do not possess the standard of chest development; and if we would be certain of absolute freedom from the possibility of an attack of the disease, then we should deliberately set to work to obtain this development. There is no difficulty whatever in doing that, for the size and shape of the chest depend upon the conditions to which it is subjected.[1] To develop the chest we must avoid those conditions that tend to disuse of the lungs, to their compression or injury, and introduce others that markedly tend to develop the lungs. If possible, the residence should be situated in the country, in a healthy suburb, or in a wide, open street. The rooms, and especially that used as the sleeping apartment, should be lofty, capacious, well lighted by windows that open, and ventilated by direct and continuous free communication with the external air, summer and winter, night and day. Gradually lower the temperature of the rooms till there is not nearly so much difference between it and that of the external air as that to which we are now accustomed. Great care should be taken about the clothing of the body. It is essential that the clothes should be made so loose that they offer no impediment to the full and free movement of the chest. When ordering clothes, be sure the measurement is taken at a full inspiration, and see that they are quite easy even then. Don't use braces, corsets, or respirators: they tend to impede the respiratory movement. Wool manufactured in such a way that it is elastic and permits free ventilation should be worn next the skin; and the under-linen should be frequently changed, so that no impediment is offered to its emanations. A sponge-bath should be taken every day. Low-heeled boots, wide, broad toes, should be worn, so that walking exercise may be taken in comfort. Spend as much time as possible, and that daily, in some form or other of active exercise in the open air. Carefully avoid the habit of stooping: throw the shoulders back, the chest forward, and get into the habit of holding the body erect at all times. Breathe through the nose, and take half a dozen deep inspirations, followed by full expiration, several times daily. Go in for gymnastics, giving special attention to the development of the muscles of the chest, swimming, singing, and athletics, and get gradually acclimatized to the external air, wind, and rain. Don't overload the body with clothes; and maintain the temperature in the natural way, by increased muscular exertion. Get the chest-girth and vital capacity taken at regular periods, and record them, so that you may know what progress you are making; and do not relax these efforts for a day until the chest-girth at the nipple line is higher than Brent's medium standard.

The members of consumptive families and those who bear the marks of threatened disease—a narrow chest and faulty carriage of the body, associated with some indication or other of deranged health—should make it the first business of their lives to carry out the above directions. Till that has been accomplished, it is worse than useless—it is certain disease—for them to engage in sedentary, chest-constricting, or dust-inhaling occupations. Those who are engaged in such occupations, or who are unavoidably submitted to surroundings that tend to reduce the breathing capacity, should most scrupulously devote sufficient time daily to one or other mode of developing the lungs, in order to counteract their effects. And I need not point out that considerations of self-interest, of humanity, and of public policy, alike de-

[1] "What is Consumption?" (1886); "The Experimental Production of Chest-Types in Man," British Association, 1887, Statistics; "Physical Development;" The Illustrated Medical News, Nov. 9, 1889.

mand that a practical effort should now be made to reduce the compression of the chest, the inhalations of small particles, and confinement, especially in rooms under ground, to a minimum in those trades.

At birth the child has a proportion of chest girth to height that slightly exceeds that of the maximum standard. I have suggested the birth standard as the true standard of health; but under the present system of bringing up children, they are, from the moment of birth right through the whole course of modern education, submitted to conditions that tend to reduce the breathing capacity; so that for a height of 51.84 inches there is a chest-girth of 26.10 inches, instead of one of 35.18 inches, or a loss, in about ten years, of nearly nine inches. And when there is consumption in the family, extra care is taken of the children; that is, these conditions are pushed to an extreme limit, and the so-called inherited consumption is the direct result. Here you have the best standard of chest-girth. Is it too much to ask that the conditions of the child's surroundings as a whole shall be so arranged that it may be retained? Look at the poor, puny chests we meet with, and at the reports of the registrar-general, and then we shall see the grave responsibility that lies upon us for producing such a change, and permitting it to continue.

I have pointed out the means by which we can develop the lungs to the required standard, and in so doing have shown how that development is to be retained, and consumption be effectually prevented. These measures are very simple; and in one form or other, and at some period or other within the twenty-four hours, they are within the reach of all. But they effect a complete change in our habits, mode of life, and surroundings; and a change of this nature must be slowly, gradually, and cautiously effected. I warn you against stretching the lungs (that is not development), against violent or sudden exertion and exhaustion. Uninterruptedly, step by step, acclimatize the bodies to the new conditions, and then they will lead us safely and surely to complete protection from consumption.

How can we reduce the mortality from consumption to insignificant proportions, and so complete the measures that are necessary to secure the practical suppression of the disease? This is the state with which we have to deal. The lungs are being progressively destroyed by a process of irritation[1] caused by more work being thrown on them than they are able to effect;[2] and this inability has been produced by their having been, and still being, subject to conditions that tend to reduce their capacity;[3] and, further, during the progress of these events, the other organs have become involved by attempting to perform compensatory work, with the result that the general health is more or less seriously compromised. Consequently, in order to adequately deal with this state of things, we must treat consumption upon the following principles: to establish an equilibrium between the amount of interchange required to be effected and that effected; to enable the other organs of the body to perform their ordinary functions; to restore to the lungs their power of adjustment to their external conditions; and to obtain the above without producing indications of friction: that is, in other words, we must arrest this process of irritation, restore the general health, and develop the lungs to the required amount, in ord to secure complete recovery from consumption. A litt consideration will make it evident, that, to carry out the first principle of treatment, we shall have to take measures from two distinct points of view. On the one hand, the conditions that impede the effecting of these interchanges must be, as far as that is possible, removed, and those that have an opposite tendency substituted; and, on the other, any deficiency that may remain must be made good by the compensatory action of one or more of the other organs. For this purpose we shall, in the first place, put the patient under conditions of habitation, habits, and surroundings that tend individually and collectively to promote these interchanges. The consumptive patient must be sent as soon as possible to live in a house the sanitary condition of which has been ascertained to be good, situated on an elevation, either in the country or at the seaside, where the air is pure and free from dust. Each room must communicate continuously and directly with the external air. Sunlight should be freely admitted; the windows constantly kept open, night and day; and the temperature, as recorded by a maximum and minimum thermometer, gradually lowered till there is not so great a difference between it and the external air as that we still find in the rooms of consumptive patients. The patient's clothes must be warm, not too heavy, and made so loose that they can offer no restraint to the free movement of the chest. Wool manufactured in such a way that it is elastic, permits free ventilation of the skin, and is not too heavy, should be worn next the body; that used during the day must not be worn at night, and the under-linen should be frequently changed. As much time as possible must be spent in the open air. If the patient is unable to walk, he should ride or drive in an open carriage till he has gained sufficient strength to enable him to do this. Sitting in a position that tends to impede the movement of the thorax must be carefully and constantly avoided, and the patient should be gradually induced to throw the weight of the shoulders on the spine till he both sits and walks with the body erect. If any deficiency remain,—and that, as well as its amount, will depend upon the extent of the disease,—we shall have to obtain compensation for it by measures that increase the activity of the functions of the skin, or the kidneys, or the alimentary canal. To increase the functional activity of the skin, we shall direct the patient to be bathed or sponged with warm water, medicated or not, as frequently as may be found desirable, once daily in any case; and, if necessary, we shall increase that activity by prescribing diaphoretics. If the action of the skin obtained by the above measures be not sufficient for the purpose, or if it be already performing its share of this compensatory work, then we shall increase the activity of the kidneys by suitable diuretics, and attend to the functions of the alimentary canal. Now, the above measures, thoroughly and carefully carried out, will, if the

[1] Tanner, Aitken, Wilson-Fox, Waldenburg, Schottelius, Roberts, Lombard, Marcet, Sanderson, Simon, Cohnheim, Frankel, Rindfleisch, Niemeyer, Powell, Ewart.

[2] Gautier, Peter, and the French School.

[3] Graham Balfour, Gintrac, Hanot (Jaccoud), Hutchinson, Fabino, Wintrich, Hecht, Schnievogt, Waldenburg, Ransome, Stokes, Frieund, Aitken.

disease be not too extensive, effect an equilibrium between the work required to be effected and the work effected, and we shall have obtained an arrest of the disease.

The first step towards enabling the other organs of the body to perform their ordinary functions has been already taken by removing that which was the primary cause of their derangement; viz., the presence in those organs of substances that interfered with their normal work, and altered, to a greater or less extent, the state of their nutrition and that of the body as a whole. We shall supplement that, where necessary, by appropriate means to secure the relief of any organ that may have become involved by its compensatory action, and to obtain the normal functional activity of the others, so that the body may be placed in a fit state for the reception and assimilation of suitable food. The nature and quantity of the food, and the time for its administration, must be carefully regulated according to the requirements of the case, but care must be taken not to give it too frequently or in too large quantities. I attach much importance to the careful cultivation of the appetite, so that the patient may be tempted to eat, and to the careful avoidance of any dish or article of food to which the patient has taken a dislike. Good new milk alone, or made up in various ways, cream, butter, olive-oil, marrow (I have found great benefit from a preparation of marrow and malt immediately after the meal), hot bacon with its fat, eggs, good beef-tea, soups, fish, fowl, cutlets, fillets, etc., with a suitable supply of vegetables and fruit, must be freely drawn upon for the patient's food. And we may add to this a good bitter beer, stout, or a good, sound claret, or wine, when we are sure we can get them.

No attempt whatever should be made to apply the third principle of treatment until the disease has been some time arrested, as shown by a progressive decrease of the symptoms of lung irritation, an increase in the area of breathing, increased vital capacity, extent of movement and girth, a nearly normal temperature, a steady improvement of the general health, and increased weight. Then the following measures may be gradually adopted and steadily increased, great care being taken to avoid either strain (the lungs must not be stretched) or over exertion, the state of the general functions and temperature being carefully watched. We place the patient under conditions that progressively make increasing demands for the use of the lungs, such as slight ascents on the neighboring hills, slowly performed at first, and then gradually increasing both the elevation and the time occupied in such exercise. Deep breathing is to be regularly practised, commencing with three or four full inspirations, followed by deep expirations, in succession, and increasing both their number and extent. I have found the careful and regular use of a spirometer very beneficial, and much regret that, as in the case of thermometers, no one as yet supplies them at such a price as will enable the general public to purchase them. Then the muscles of the chest must be fully developed, and the patient should take part in such exercises as will insure their full use. And this process of lung development will not be complete until the patient's vital capacity exceeds Hutchinson's so-called standard of health.

And we shall attain the object of the fourth principle of treatment by carefully selecting appropriate measures to effect each purpose we have in view (and the medicines must be prescribed precisely on the same principle; for instance, if we desire to increase the functions of the skin, a diaphoretic is prescribed, and its use stopped when we desire such action to cease), by using them at the right time and to the right extent, and by carefully watching their effects, so that if there be any indication of friction we may at once effect the necessary modification, or adopt some other means to attain the same object.

Under this system of treatment, the chest symptoms are immediately relieved; pain, cough, and expectoration speedily disappear; the area of breathing, the vital capacity, the chest-girth, and extent of movement, progressively increase. The temperature tends towards that of health, the general state improves, the weight increases, and there is a feeling of health and strength. In fact, so real is this, that it has been the source of one of the chief difficulties of treatment, by tempting the patient to do something beyond his strength, or to neglect some of the directions given him, till he finds himself promptly pulled up by a cessation of his improvement. Soon, in those cases in which the disease is not extensive, there is a complete arrest of the disease, no chest symptoms, a good state of the general health, a fair weight, normal temperature, a good breathing capacity, and eventually the patient makes a complete recovery. By this I mean he has the appearance and possession of sound health, natural breathing from base to apex, a well-formed and fully developed chest, and a good range of movement and vital capacity.

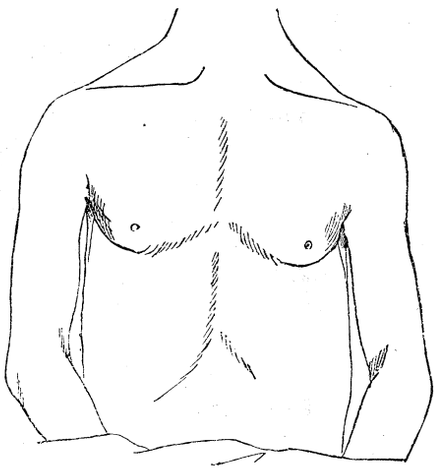
I have based this statement on the results I have invariably obtained in my experiments, and in the practical treatment of the cases of which the following notes appeared in the *Lancet* of Nov. 26, 1887, and Dec. 8, 1888, and in the *Illustrated Medical News* of Oct. 26, 1889:—

"CASE I.—In April, 1883, I saw H. O. M. E., a married lady, in conjunction with the gentleman who had attended her. We found the usual signs of phthisis of the right lung. Family history good; height 5 feet 2 inches; vital capacity 85 cubic inches. I accompanied the patient to Hastings, and saw that she was carefully treated on the principles I advocated in that paper.[1] June 13, much improved; vital capacity 130 cubic inches. June 21, improvement continues; now able to walk a mile or two; vital capacity 162 cubic inches. June 29, able to walk four miles; vital capacity 167 cubic inches. The patient was unfortunately obliged to return to town. The improvement stopped, and after a few weeks she began to lose ground. In September the patient went to the Isle of Wight, the vital capacity then being only 161½ cubic inches. Oct. 9, very much improved; vital capacity 195 cubic inches. She continued in the south, and was gradually accustomed to walk many miles daily; no chest symptoms. Nov. 4, patient's appearance that of a lady in good health; vital capacity 201½ cubic inches. Nov. 25, continues well; vital capacity 222½ cubic inches. Dec. 11, patient has recovered; angles of scapulæ lie flat on back,

[1] "The Scientific Treatment of Consumption," Manchester Meeting of the British Association.

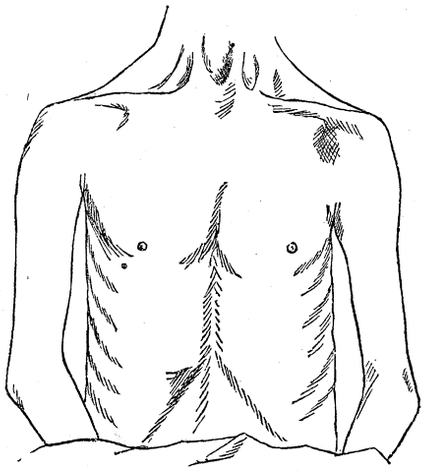
chest freely movable, and vital capacity 226 cubic inches, or 44 cubic inches above the so-called standard of health. Since that date the patient has had two children, there has been no relapse, and in September last her vital capacity was 220 cubic inches.

"Case II.—L. J. F. was said to have disease of the right lung by family doctor. The patient's father and uncles had died of consumption. I found the disease very limited, and the case a most favorable one to treat. Height 5 feet 6 inches; chest-girth at third rib 30 inches; extent of movement ½ inch; girth at ensiform cartilage 29 inches, extent of movement 1¼ inches. Treated on the same principles, the patient steadily and rapidly improved in condition. Two months later the chest-girth at the third rib was 32⅛ inches, extent of movement 1⅝ inches; girth at ensiform cartilage 30 inches, extent of movement 3 inches. Two months after the above, the patient had practically recovered. There was a further gain of half an inch in girth; no depression above or below clavicles; angles of scapulæ flat, and weight 9 stones 5 pounds. The patient continues well.



"Case III.—This was a servant, with disease of both lungs. The patient was sent home to the country apparently recovered, and desired no further attendance. I have since lost sight of her.

"Case IV. is that of myself. It will be fully understood that I only refer to it to complete the *prima facie* case I have established in support of this method of treating the disease. My mother, her three brothers, and two sisters died of phthisis. In physical appearance I was a well-marked example of the so-called 'inherited' disease. Height 5 feet 9½ inches; vital capacity considerably below the so-called standard; was always subject to winter cough; broke down while attending hospital in 1873, and was advised to leave at once, in the middle of the session. There was no doubt about the nature of the disease. Since that time I have gained about five inches in chest-girth, and for ten years have been free from any sign, symptom, or appearance of the disease.



"I shall be obliged if you will enable me to state that those patients continue well, notwithstanding the severity of last winter, and that their remarkable increase of chest-girth and range of expansion has been retained. Since then, I am sorry to say, I have only had an opportunity of applying those principles of treatment in two cases.

"The first case was an acute attack, temperature over 102°, in a case of long-standing and very extensive disease of both lungs. Under treatment, the temperature became nearly normal, cough and expectoration nearly disappeared, breathing became easy, the chest-girth increased, and in about six weeks the patient returned to work. A short time since, I heard that the patient was fairly well, and still able to continue at work; and, had there been a home placed under conditions suitable for treatment, I think this case would permanently recover, notwithstanding the extent of the disease.

"In the other case there was extensive disease of the right, with commencing disease of the left lung, and hectic. The patient could not leave his business, but carried out the directions so carefully that cough and hectic disappeared; the appetite was good, weight increased, and there was no difficulty in breathing on exertion. In fact, he felt and looked so well that he spent a day at Wimbledon, got thoroughly wet through in the camp, and remained in his wet clothes. That brought on an acute attack, and his temperature rose to over 103°. Under treatment, this was rapidly recovered from, and in three weeks he was fit to go, and went, to the Highlands. During the attack the patient lost eight pounds in weight; the heart was displaced to the right; and the chest-girth at ensiform cartilage was, on expiration 27½ inches, and on inspiration 28⅛ inches. The patient has no trouble with cough; the color is healthy; temperature nearly normal; weight has increased 12 pounds; heart has gone back; chest-girth at ensiform cartilage is, on expiration 28 inches, on inspiration 30½ inches; and there is no difficulty in breathing or cough when the patient runs."

"The cases previously reported continue well. Of the two cases which were noted in the *Lancet* of Dec. 1, 1888, one (Case 5), I understand, continues at work, and the other (Case 6) has had a most instructive record. This patient went through the winter very well, and I did not see him till the 29th of May, when, as the direct result of recent overwork in his business, I found he had materially lost ground, but unfortunately he could not leave town. A sharp attack of hæmoptysis came on on the 29th of June, and I was sent for. The temperature rapidly rose to 103°, but was promptly reduced, the hemorrhage arrested, and in a few days the patient was up. He left for the Highlands on the 19th of July, when his chest-girth was, on inspiration 30⅝ inches, and on expiration 30¼ inches, the extent of movement being only ⅜ of an inch. I next saw him on Oct. 3, his chest-girth being, on inspiration 32 inches, expiration 30 inches, showing an increase of 2 inches. This was associated with a considerable improvement in the local and

general state, weight 9 stones 4 pounds, and I am well satisfied with his progress.

"CASE VII.—On May 21 first saw this patient. Father and his brothers had died from consumption. Occupation dust-inhaling; liable to colds, slight cough, hectic, frequent diarrhœa, voice changed, and face pale; height 5 feet 5¼ inches; chest girth at ensiform cartilage, on inspiration 27½ inches, expiration 25 inches. Commencing disease of right lung. June 26, appetite fair; air entering more freely; chest-girth, on inspiration 28½ inches, expiration 26 inches. July 24, looks very well, sleeps well, appetite good, no cough, voice natural, temperature normal, air entering freely everywhere, good movement; chest-girth, on inspiration 29¾ inches, expiration 27 inches, showing an increase of 2¼ inches. The patient has practically recovered. Still well.

"CASE VIII.—Patient's mother's family consumptive. Dust-inhaling occupation. Has had cold upon cold, pale, appetite bad, fingers clubbed, pain over middle of third right rib, cough troublesome; temperature 99.1°. Disease of both lungs. Height 5 feet 9¼ inches; chest-girth, on inspiration 36¼ inches, expiration 33¼ inches. June 18, says he is first-class, looks better, appetite good; no cough, no pain in chest; air entering freely, more movement, apices higher; and chest-girth, on inspiration 37¾ inches, expiration 35 inches. July 17, sleeps well, eats well, and looks well. Temperature normal; weight 10 stones 9 pounds; no pain, no cough, no expectoration; air freely entering everywhere; and chest-girth, on inspiration 38 inches, expiration 34¾ inches, being an increase of 1¾ inches. Patient has nearly recovered, and returned to work. Continues well.

"CASE IX.—This patient has been getting thin, feels weak, pale, and appetite capricious. Occupation in a basement partly lighted by gas always. Commencing disease of left lung, breathing generally feeble, and very little movement. Temperature 96.6°; height 5 feet 8 inches; chest-girth, on inspiration 35 inches, expiration 32 inches. Aug. 29, says he feels quite well, and looks it; air entering freely everywhere, movement good; chest-girth, on inspiration 37¼ inches, expiration 32¼ inches, showing an increase of 2¼ inches; temperature normal; weight 10 stones 3 pounds. This patient is practically well. Still well.

"CASE X.—Patient has been losing weight for about twelve months, appetite very bad, cough very troublesome, hectic, perspiration at night; temperature 99.4°; height 5 feet 5 inches; chest-girth at ensiform cartilage, on inspiration 26½ inches, expiration 25¼ inches; very little movement, very little air entering; disease of both lungs. Sept. 18, has been to Hastings. Looks well, sleeps well, cough only occasional when exposed to cold, appetite wonderfully good, voice greatly improved, air entering freely, fair general movement; chest-girth, on inspiration 29½ inches, expiration 26¾ inches, showing an increase of 3 inches. Making splendid progress.

"CASE XI.—Saw this patient on the 10th of July. Disease of both lungs. Temperature 99°; expectoration colored, cough very troublesome, had been losing weight; chest-girth, on inspiration 26 inches, expiration 24¾ inches. Sent to Hastings. Sept. 29, looks very much better, little cough, appetite good, steadily putting on flesh, air freely entering, movement good; and chest-girth, on inspiration 28¼ inches, expiration 25¼ inches, being an increase of 2¼ inches. This patient is making most satisfactory progress.

"CASE XII.—Patient has extensive disease of both lungs. Hæmoptysis six years ago, and from time to time up to date. Has tried Madeira, Torquay, etc. Height 5 feet 7⅝ inches; chest-girth, on inspiration 25 inches, expiration 25¼ inches. Sept. 27, decidedly better, breathing much easier, more air entering generally, moist sounds clearing up; chest-girth, on inspiration 27½ inches, expiration 26⅝ inches, showing an increase of 2¼ inches. Going to Hastings. There is a little hope for this patient."

Further, the literature of consumption supplies us with a mass of evidence that clearly and unquestionably points to the accuracy of the above results. In the first place, an examination of the circumstances in which the numerous recorded cases of arrest, whether for a longer or shorter period, have taken place, shows that conditions that tend to obtain compensatory action by one or more of the other organs, those that tend to develop the lungs, or both associated together, were always present. Formerly arrests were sometimes obtained by the induction of an artificial skin-disease, by the use of counter-irritants, by bathing and sponging, and by preparations acting on the skin, kidneys, and digestive tract. Patients sent to hilly districts in the country, to the seaside, to warmer climates, where more time was spent out of doors, or to the mountains, have obtained an arrest of the disease, and similar results have followed the taking-up of the trade of testing wind-instruments or practising various methods of inhalation.[1]

Not only have such conditions been invariably present where a temporary arrest has been effected, but they also, and especially those that tend to develop the lungs, have always been for a long time present in all the cases in which a complete cure has been obtained.[2] We know that men have completely recovered after following an occupation in the open air for many years, after long residence in mountainous districts, after many years spent in constant travelling, and after leading an active life on the borders of civilization in all parts of the world. Such are the thousands of happy results that have been so correctly described by Walshe as "Nature's cures." But there was a physician who could, and did, cure consumption by a definite method of treatment, as distinguished from the accidental nature of the recoveries above referred to, and that was Sydenham. He ordered his patients to continuously ride on horseback till they got well. This exercise was to be taken in the country, where the air was good; the riding was to be increased from seven to one hundred and fifty miles a day; and the patients were only to stop for food for themselves and horses, and not to remain more than one night in a place. And of this method of treatment he said, "I have put very many upon this exercise, and I can truly say I have missed the cure of very few."

[1] Ruehle (Ziemssen), Meckel, Powell, Ewart, Hanot (Jaccoud), Hirtz, Magnus Huss, Blake, Roger and Boudet, Heitler, Laennec, Cotton, Clark.

[2] Frieund, Case in Royal Infirmary, Edinburgh (Lauder-Brunton), Cruveilhier, De Mussy, Fuentes, Harrhy, Stokes, Ewart, Herman-Weber, Andrew, Austin Flint, Fuller, MacCormac, Germain Sée, Hastings, etc.

We are now in a position to state the case that has been laid before us. We have seen that the accepted theories of consumption must be rejected, because they either have no foundation in fact, or they do not accord with and are incapable of affording an adequate explanation of all the known facts of the case; and that Koch's theory falls within these categories. A new theory—that consumption is the direct result of the reduction of the breathing surface of the lungs below a certain point in proportion to the remainder of the body, and is solely produced by conditions that tend to reduce the breathing capacity—has been brought before us, and the following evidence adduced in its support:—

1. Consumption has been experimentally produced by conditions that tend to reduce the breathing capacity. Koch's successful experiments were directly produced by those conditions.

2. We can at any time watch the direct production of consumption by these conditions in the dust-inhaling trades.

3. The trades and occupations that directly compress the thorax, or impede the respiratory functions, are notorious for their production of consumption.

4. A large amount of consumption is produced in the army every year by those conditions.

5. Consumption has been repeatedly produced by confinement, both in man and in animals.

6. The children of consumptive parents who become diseased have been carefully brought up under such conditions.

7. Consumption bears the mark of the effects of the progressive action of such conditions from its commencement to its termination.

8. There is no recorded case of consumption, experimental or not, in which those conditions were absent.

9. Where such conditions are absent, there is no consumption in man or animal.

10. Upon their introduction, consumption immediately appears, both among men and in animals.

11. The disease presents a perfectly natural series of events when viewed in this light.

12. Its presence in our midst is due to the changes in our habits, mode of life and surroundings, that are being effected by the progressive advances of civilization.

13. Consumption has been prevented by the removal or counteraction of those conditions. The immunity of mountaineers is due to their capacious lungs.

14. The disease has been frequently arrested for a longer or shorter period by the accidental or deliberate adoption of measures that tended to compensate for or counteract those conditions.

15. And both the experimental and the practical application of measures that tend to compensate for and counteract those conditions have invariably been followed by the arrest and subsequent complete recovery from consumption, where the disease was not too extensive; and the same process has obtained in the thousands of cases of cure by nature and by Sydenham. Therefore this theory is founded on fact, and is both in strict accord with and capable of affording an adequate explanation of all the known facts of the case. And consequently we now have it in our power to secure, with absolute certainty, the prevention of and recovery from consumption. I have laid down the principles that must guide us in carrying out this work, and now it only remains for me to point out the directions in which we must move, in order to secure the general application of this knowledge, and the consequent practical suppression of consumption. The State loses the services of a large number of men every year from consumption in the army and in the various departments of the civil service. That not only represents a considerable financial loss, but in the case of the army it also constitutes a serious source of danger to the State. The trades and occupations that produce so much consumption should be the subject of careful inquiry to ascertain how this production can be reduced to a minimum. That this inquiry is urgently called for, is evident from the following statistics, taken from the supplement to the "Registrar-General's Report," which show, that, out of a thousand deaths among various classes, there were from phthisis,[1] among Cornish miners, 690; earthenware-manufacturers, 473; printers, 461; file-makers, 433; cutlers, etc., 371; brewers, etc., 334; stone-quarriers, etc., 308; drapers, etc., 301; publicans, etc., 295; tailors, 285; cotton-manufacturers, etc., 272; wool-manufacturers, 257; shoemakers, 254; builders, etc , 252; carpenters, etc., 204; hosiery-manufacturers, 168; laborers (agriculture), 122; gardeners, 121; fishermen, 108; farmers, etc., 103

Physical education should be made a necessary part of our system of national education. We look to the government for action in the above directions, and their serious and immediate attention should be given to them. Life-assurance companies and sick-benefit societies can co-operate most materially in the prevention of consumption, and save their members considerable sums of money annually by insisting upon their members having or obtaining the required amount of lung development. And every available opportunity should be taken of placing before workingmen's clubs and societies the immense importance of physical development.

It is of great importance that the consumptive patient should be placed under treatment as soon as possible, and that it be uninterruptedly continued until the recovery is complete. For this purpose we require hospitals and institutions placed in the most favorable conditions in the country and at the seaside, and I am sure the means will be gladly found for opening these institutions when once their necessity and immense importance have been realized. With such institutions, so placed, and this system of treatment thoroughly and continuously carried out, I am certain we shall have reduced the mortality from consumption to truly insignificant proportions before the next century has escaped from its infancy. And I have the right to express a clear and emphatic opinion on this subject; for I myself and my patients have unquestionably completely recovered from the disease. A great, a splendid, a noble victory over this disease lies in the hands of the profession. Shall we let doubt stand between us and its practical achievement?

G. W. Hambleton.

[1] The disease is very rare among gypsies.

NOTES AND NEWS.

DR. DIXON, professor of hygiene at the University of Pennsylvania, has been making some experiments with air and dust obtained in street-cars. He has found in them the germs of many diseases, contagious and otherwise. Better ventilation and more effective cleansing are sorely needed.

—Mr. Allan V. Garrat has tendered his resignation as secretary and treasurer of The National Electric Light Association, to take effect June 15, 1890.

—The directorate of the railway intended to connect Hudson Bay with the Canadian railway system has been recently reorganized, and, it is expected, will be able to carry the undertaking to completion. The length of the railway is to be 350 miles, starting from North Bay, off the Canadian Pacific Railway at Lake Nipissing, thence to Moose Factory, a port on James Bay, the southern prolongation of Hudson Bay. This, it is expected, will become an important feeder to the railways already built, passing as it does through one of the richest pine regions in the Dominion, containing forests of red and white pine, spruce, and tamarac of gigantic proportions. The country traversed is also said to be rich in minerals, such as galena, copper, nickel, and iron.

—M. Georges Rolland, an eminent French engineer, recently read a paper before the Académie des Sciences, in which he insists upon the necessity of constructing a railway across the Sahara. M. Rolland says that it is time for France to make up her mind as to the part which she intends taking in the economic conquest of the interior of Africa. In his paper he defines what are the regions of the western and central Soudan upon which French commerce could reasonably reckon, his conclusion being that nothing durable or really useful could be effected in the Soudan without the assistance of Algeria; while, in order to take any effective action in Algeria, that colony would need to be connected with the Soudan by means of a railway crossing the Sahara.

—A club of students, under the charge of four experienced tutors, will be formed at Seal Harbor, Mount Desert, Me., for study and tuition during the summer of 1890. The object of the club will be to prepare students for the college entrance examinations in the fall, and also to assist any who have fallen behind in their studies in making up their deficiencies. The club will be under the charge of Louis L. Hooper (Harvard '89), assistant in physics in Harvard College, who was at the head of a similar club successfully carried on last summer at North Edgecomb, Me. He will be assisted by L. H. Dow in ancient languages, N. R. George, jun., in mathematics and physics, and J. B. Scott in modern languages, all of whom hold very high rank in the present senior class of Harvard College. They have specialized in their several departments, and are experienced tutors. As each student will receive separate and individual instruction in all his studies, his peculiar needs can be met, and rapid and thorough progress can be made. Although the club is organized principally for study, there will be ample opportunity for exercise and recreation. A tennis court and row-boats have been secured, and, as is well known, the neighborhood offers remarkable advantages in the way of excursions and mountain-climbing. For further particulars, address Louis L. Hooper, Harvard University, Cambridge, Mass.

—At a regular meeting of the Washington Chemical Society, April 11, Dr. Thomas Taylor of the United States Department of Agriculture exhibited a new flash-light intended to take the place of several kinds which have of late proved highly dangerous in practice. The composition of Dr. Taylor's new flash-light consists largely of charcoal made from the silky down of the milk-weed,—a form of carbon which he prefers to all others, because of its freedom from ash. A few grains of this new composition placed on tissue-paper and lighted by a punk-match produced a prompt and blinding flash, while it was observed that the paper on which the powder rested was not even scorched. The flash being instantaneous, the heat is not sufficient to ignite the most inflammable material on which the powder may rest. Dr. Taylor demonstrated this by using, with the same paper for a base, an inferior flash-light, which set fire to the paper at once. This is owing to the comparatively slow combustion of the chemicals used in the inferior grade. Dr. Taylor said that the powder of his new flash-light will not explode either by concussion or friction.

—On Monday evening, April 21, at the meeting of the section of mineralogy of the New York Academy of Sciences with the New York Mineralogical Club, Mr. George F. Kunz spoke on the subjects of "The Minerals exhibited at the Paris Exposition of 1889" and "A Remarkable Group of Meteorites from Kiowa County, Kan.;" and Dr. Joseph H. Hunt exhibited a collection of specimens from Paterson, N.J., consisting of zeolites and quartz pseudomorphs after zeolites. Mr. Kunz also exhibited a new and undescribed meteoric iron from Colfax, Rutherford County, N.C., and spoke on the asteriation in calcite as observed by putting a light through transparent cleavages, on the native antimony from Kern County, Cal., and on the pallasites and meteoric iron from Kiowa County, Kan.

—The following is a complete list of the papers read before the National Academy of Sciences, at its April meeting, 1890: "The Effects of the Inhalation of Nitrogen, Nitrous Oxide, Oxygen, and Carbonic Acid upon the Circulation, with Special Reference to the Nitrous Oxides, Anæsthesia, and Asphyxia," by H. C. Wood; "On the Application of Interference Methods to Astronomical Measurements," by A. A. Michelson; "Physiognomy of the American Tertiary Hemiptera," by S. H. Scudder; "Totality of the Eclipse of 1889, Dec. 22," by D. P. Todd; "The Budding of Salpa considered in Relation to the Question of the Inheritance of Acquired Characters," by W. K. Brooks; "Recent Advances towards a Knowledge of the Fishes of the Great Oceanic Depths," by G. Brown Goode and Tarleton H. Bean; "A System of Classification of Variable Stars," by S. C. Chandler; "On the Spectrum of Metals," by H. A. Rowland; "On the Cheapest Light," by S. P. Langley; "On the Relation of Secular Disintegration to Certain Crystalline and Transitional Schists" and "On the Structure of the Green Mountains," by R. Pumpelly; "The Interrelationships of the Ichthyopsida," "The Notacanthoid Fishes as Representatives of a Peculiar Order," and "The Halosauroid Fishes Typical of a Special Order," by Theo. Gill; "Researches on the Double Halides" and "Researches on the Sulphinides," by Ira Remsen.

—The faculty of the Wharton School of Finance and Economy, at the University of Pennsylvania, have been steadily developing during the past months a library, which, now that it has reached very large dimensions, is making its importance felt. The foundation was laid by the great collection of the late Stephen Colwell, comprising between seven and eight thousand volumes, and including nearly every important book on the subjects of finance and political economy in the English, French, and Italian languages published before 1860. This was supplemented by the bequest of the library of the late Henry C. Carey, which embraces many later works and pamphlets, and is especially rich in statistical literature, European government reports, and the like. Some time since, in addition, a collection of about three thousand English pamphlets on financial and economical subjects, formerly the property of Mr. McCalmot of London, was obtained, covering the period from the close of the seventeenth century to our own time, and bound in chronological order. Professor Bastable of Dublin has pronounced this to be better than the similar collection of the British Museum. It is necessary, of course, in order to keep pace with the times, to buy the best of the new books within the scope of the Wharton School. An annual fund has accordingly been provided for this purpose; and a number of works, several of them fresh from the author's hands, which were selected by Professor James while abroad last summer, have lately arrived at the university. A department of the library of especial interest is that pertaining to municipal government. It is hoped that all documents pertaining to this subject for cities of over fifty thousand inhabitants may be obtained. The co-operation of all municipal officers is urgently requested, and the receipt of any documents, however trifling, will be gratefully acknowledged.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

ALL THE STATES OF SOUTH AND MIDDLE AMERICA have of late years shown great solicitude about the condition of the national education, but none more so than the Argentine Republic. Dr. J. B. Zubiar has just published a little pamphlet entitled "Quelques mots sur l'Instruction dans la République Argentine" (Paris). He is inspector of the national schools and training-colleges, and was his country's delegate at the last Paris exhibition and at the pedagogical congress held on that occasion. The object of his pamphlet is to show to the civilized world what progress the Argentine Republic has made since it succeeded in shaking off the clerical government of Spain, which had for three centuries held it down. The following facts need no comment. In 1810 the only places where teaching went on were a theological college and a few schools kept by priests, who taught the young idea how to shoot chiefly by means of the cane. In 1888, after fifty years of independence, there are for the forty million inhabitants two universities with three faculties each, 15 colleges, 34 training-colleges with 758 professors and 11,365 pupils, 2,263 elementary schools with 4,744 teachers and 175,239 pupils (which gives an average of 34 to each class only), and, besides, 831 private elementary schools with 1,094 teachers and 33,723 pupils,—altogether 3,227 schools with 254,608 pupils. In commenting on this report, the *Journal of Education*, London, states that the great impulse to education was given by the law of 1789, and ever since the work has rapidly extended. In one year, 1887–88, there was an increase of 109 schools, with 1,000 teachers and 27,158 pupils.

MENTAL SCIENCE.

A Study of Movements in Young Children.

MODERN science attaches great importance to the study of beginnings, and such study is quite as promising and interesting in the field of mental as of physical facts. The origin and growth of human faculty as exemplified in the development of the child claims an especial importance on account of its very general and educational interest. Quite a number of child biographies have been written from this point of view, and the period has now come when special studies of particular lines of development and acquisition of faculty are made. A recent study by M. Binet (*Revue Philosophique*, March, 1890) deals with the following four points: the co-ordination of movements in walking, the bilateral character of movements, automatism in movements, and re-action times.

The study of how children learn to walk has been confined mainly to determining the age at which independent locomotion begins: this in the average of a number of infants was found to be at about eighteen months. It varies considerably with the health and growth of the child, and also with the degree of attention the child gives to the learning of it. M. Binet tells of two sisters, the elder of whom learned to walk at twelve months by carefully and persistently leaning on one chair, feeling the way to the next, and so on; while the younger, who was stronger and had every opportunity of learning quickly, made very intense but irregular efforts to walk, and did not succeed until her fifteenth month. This difference of character has been maintained, the elder being calm, serious, and not easily distracted, while the younger is exuberant, easily distracted, and volatile. The origin of the tentative movements resulting in walking, Preyer regards as instinctively inherited, and in this opinion M. Binet concurs. The latter observed in an infant only three weeks old alternate movements of the legs when the child was held with the legs free to move, and the soles of the feet were in contact with any substance. Repeated experiments showed that if the child were held with its feet above the ground, no such alternating movements of the legs occurred, but as soon as the feet touched the floor these movements were reflexly excited. This seems to indicate that the movements of walking are instinctive; it also indicates that the fact of walking being a power which the child acquires somewhat late does not interfere with its instinctive character.

If one observes the spontaneous, explosive movements of the arms and legs of infants a few weeks old, one will notice a great preponderance of bilateral movements; the two arms or the two legs moving together, or, if not quite together, alternating so rapidly as to amount to the same thing. The contrast in this respect between the infant and a child of two or three years is very marked. Of 57 movements made by an infant one week old, only 13 were unilateral, 25 were bilateral, and 23 of the rapidly alternating kind. This tendency towards bilateral movements can be observed in older children. Rubber tubes were placed in the hands of a three-and-a-half-year-old child with the request that at a given signal she should press only one of the tubes. The record showed very frequently that both were pressed, and other irregularities occurred. In connection with these movements, M. Binet's attention was called to the expression of fear in the child when not securely held. This was very evident by its crying, which ceased as soon as the child was securely held. This occurred before the child had had a fall, and so would suggest a sort of instinctive fear of falling,—a fear which does not exist with regard to fire, for instance.

Recent researches have attached great importance to the phenomena of automatism, or the subconscious reception of sensation, and execution of appropriate movements. In a single child such automatism was evident during the first six months of life. If the child's hand were open, a light pressure on the thumb sufficed to make it close, and when closed a stroking of the back of the hand opened it. This succeeded as well whether the child was awake or asleep, whether the child directed its attention to the hand or not. The same automatic faculty comes to the front in many ways. If a child's interest is held towards a certain point,

one may slip a key or other object into a child's hand and have it held until the hand opens and the key falls, evidently without the child's knowing it. The ease with which a child may be distracted is well known. A crying child is appeased by drawing its attention away from the source of trouble. The case is cited of a child much put out by being presented to strangers, but who at once stopped crying when a match was lit. As soon as the match went out, the crying recommenced, and so on, for several minutes. We here see an alternation of the mental view that would be regarded as abnormal in the adult. The contrast between this and the elaborate means necessary to gain mental diversion in adult life is certainly striking.

The time of mental acts can be studied in children old enough to understand what is asked of them. Ordinary observation shows that children are slow in responding to a stimulus. Actual measurements were taken by having children press upon a tube as soon as they heard a sound. The average adult time for this re-action is .14 of a second. Children from four to seven years old require over half a second to do the same thing. The times, too, are irregular, from a minimum of one-fifth of a second to a maximum of a second or more, indicating an irregularity in the power to fix the attention upon so artificial a task. When the time was measured, the curve of contraction was also written. This in the adult is a quick, sudden stroke, occupying about .34 of a second. In three of the children the movement occupied over half again as much time, and in one child was as long as two seconds. This suggested a test of the maximum number of pressures a child and an adult could make in a given time. The adult makes 18 (in an extreme case 27) in 4 seconds, while the children averaged only 9 pressures in the same time. We have thus indicated in a variety of ways the gradual development of human faculty, as well as the unconscious education we pass through in childhood, and the means of educationally utilizing it.

The Sensations of Movement

We are getting to appreciate more and more how much of mental life is founded upon the information obtained through the contraction of muscles. The exact determination of how this knowledge is obtained becomes correspondingly important. A recent study by M. Bloch sheds interesting light on some phases of this question (*Revue Scientifique*, March 8, 1890). It is to be observed at the outset that we have no direct knowledge of the muscular changes produced in the muscles themselves when they contract. When we close the hand, all the sensation is in the hand itself, while the muscles whose contraction brings on the movement are farther up in the fore-arm. It is, then, from the sensations of compression of the skin and the movement of joints that we obtain our notions of movement. There are indeed certain secondary associative contractions of muscles, coming a slight fraction of a second after the contraction of the muscle we innervate, that seem to tell us of the realization of the intended contraction. While thus ignorant of the means of muscular contraction, we can direct its extent and direction. We can set the vocal chords to sing a certain note, but in many cases these adjustments are simply a series of tentative attempts, and even then liable to some considerable errors. For the motions of the arms this was tested in the following way. The two leaves of a screen standing at about an angle of eighty degrees to each other had their sides covered with ruled paper, and the general problem was for the observer in a definite position in front of the screen to find with the two arms corresponding places upon the two leaves of the screen. The movements of the two hands were most nearly alike when the movements were nearest to the body and near the line of the eyes, although the eyes in these experiments were of course closed. The difference in position of the two hands is about 1 centimetre in this region; this when the two hands are moved together. If the one hand is placed, and the other is to find a corresponding position, then the task is much more uncertain, and the error larger; the error being 5 centimetres, where it was but 1 centimetre before. If this process depends upon the contraction of muscles, then the error should be larger if the one arm is moved passively by an assistant, while the other arm finds the position in which the first was placed. An actual test showed that under such conditions the process is quite as exact as before. This independence between the perception of the position of our limbs and the muscular contraction was further shown by placing the wrist of one hand through a ring suspended by a rubber band from the top of the screen. To find a place low down on the screen, the hand must pull against the rubber band, and this should make all the adjustments too high; but no such effect occurs. Again, if a weight of 2 kilograms be attached to either wrist, it does not change the accuracy of the adjustments. Another kind of muscular sensation was tested by taking a number of leaves of a book in between the thumb and forefinger of one hand, and finding with the other an equal number of leaves. This error for a small number of leaves was about one fifteenth the number of leaves, but for a larger number this ratio decreased. It makes some difference whether the right or the left hand is the judging hand; and for M. Bloch, who is left-handed, the left hand feels lengths as larger than equal lengths in the right hand.

We also have no definite knowledge of the precise time of a muscular contraction. If we attempt to beat time with a metronome by the rhythmical contraction of a muscle, we imagine that we begin the motion as the metronome beats; but in fact it is the end of the movement that coincides with the beat of the metronome, the real contraction preceding it by a considerable fraction of a second. More curiously still, if an impulse is sent out at the same time to a muscle near the brain (say, the muscles moving the jaws) and to muscles far away (say, those moving the foot), the impulse will reach the foot later. If, now, we keep time with a metronome by alternately contracting the jaw and the foot, then we really begin the movement of the foot earlier than that of the jaw, so that the close of the movements shall coincide with the sound.

The intensity of muscular sensations, M. Bloch subjected to only a very rough test. After many unsatisfactory modes of testing, he used a form of balance, on the short arm of which was suspended a constant weight, and along the long arm of which the finger moved, keeping the beam horizontal. The finger was placed in a certain position, and then moved as little one way or the other as was necessary to tell that the pressure had changed. From this the ratio of pressures at the two positions was calculated, and found to be about 1: 4.3. In this both the muscle sense and the pressure-sense are used. To rule out the former, a brace was placed above the beam, so that the weight pressed against the finger, but the latter need not support it. The ratio thus determined was 1:3. The pressure-sense was eliminated by wrapping thread around the finger, and then the sensibility was determined to be 1:2.5, so that both these senses contribute to the common result.

BOOK-REVIEWS.

A Primer of Phonetics. By HENRY SWEET, M.A. New York, Macmillan. 16°. 90 cents.

THIS work makes use of "Visible Speech" to teach the elements of phonetics, and to denote the analysis of English, French, and German sounds. All the details of "Visible Speech"—its organic and phonetic classifications, its terminology, and even its symbolic notation—are borrowed in wholesale, in a way that, however flattering to the author of the system, cannot be satisfactory to its students: for Mr. Sweet has made "a few modifications" of the symbols; and, notwithstanding that these have been repudiated by the author of "Visible Speech" as not in harmony with the fundamental principles of his system, they are here incorporated with it, without any indications to distinguish the innovations from the original parts of the scheme. The "Visible Speech" notations should at least have been shown in comparison with the substitutions, so that a student might use the one or the other, as his preference might dictate. Without the symbols themselves, the objectionable character of the "modifications" cannot be made clear; but the ground of the objections will be understood from the statement that the mutual relations of the

sounds of *p b m, t d n, k g ng*,—depicted in the "Visible Speech" symbols,—are entirely *in*visible in the substituted symbols for the sounds of *m n ng*. So, also, for the symbols of *s sh th*, —which form a related series in "Visible Speech,"—the "modifications" depart altogether from the original plan of symbolization by substituting a set of merely arbitrary forms.

In some few points Mr. Sweet disputes the correctness of the "Visible Speech" analysis; for example, in the sound of *ah*, the "low back wide" vowel which Mr. Sweet says should be the "mid back wide." Such difference of opinion is of course legitimate, but each opinion should be attributed to its proper author. In the preface to this book Mr. Sweet says, "I feel convinced that the path of progress lies through the 'Visble Speech' analysis, and that the first duty of the very few who have a practical command of it is to do what they can to spread the knowledge of it." Yet in the above case Mr. Sweet gives his own analysis only, and makes no reference to its divergence from that originally made, and still upheld, by the author of "Visible Speech." The same procedure is further manifested in the introduction of symbols for the teeth, turned in different directions – as, surely, never teeth were turned – to represent the sounds of *th* and *f*. In reference to these symbols, Mr. Bell says, in his "Lectures on Phonetics," "The symmetry of the system has been deformed in republications which have been made without leave asked or given. One emendator, it seems, had supposed the system wanting in symbols for the teeth, and accordingly he actually provided it with a set. 'Visible Speech' was certainly not born with teeth; or, rather, teeth being in the mouth, their presence is implied as a matter of course, and requires no symbolizing – as they are not in the habit of shifting their root-fast positions. The teeth, like the hard palate, are only passively employed; and it will be time enough to call in dental aid when the teeth are shown to be the active agents in forming any oral sound."

In spite of this protest, Mr. Sweet brings in his symbols for the teeth, without a word to show that they form no part of the original system. This is altogether indefensible. "Visible Speech," as we learn from the inaugural volume, cost its author the labor of twenty years: and, although its inventor might be scientifically glad to see his system superseded by a better, no person can look with equanimity on wanton interference with so elaborate a plan. All that Mr. Sweet has to say in his "Primer" might have been said —if not better said—within the limits of the symbolism that has not, we are told, been found wanting in means to discriminate the phonetics of any language. Mr. Sweet's "modifications" cannot be accepted as legitimate; far less can they be considered as improvements: but the chief objection to them is that they are mixed up with the true "Visible Speech," as if they formed part of the system. In it, yet not of it, they misrepresent it, and mislead the learner.

Simple Elements of Navigation. By LUCIEN YOUNG. New York, Wiley. 16°.

To the yachtsman who annually, and about this time of year, goes down to the sea in a schooner, or a sloop, or a cutter, or perchance in a steam or naphtha launch, this little pocket-volume will prove invaluable; and to the naval apprentice, the petty officer, or the ambitious able seaman, it will be of greater immediate assistance on the road to promotion than more pretentious works intended for the use of accomplished mathematicians and experienced navigators. The treatise is not intended to take the place of any other work, for we know of no other of similar scope; nor does it aim to supply any real or imaginary deficiency in previous works on the subject. It is put forth as a compendium or epitome of the simple elements of navigation, containing every thing necessary to enable a man of ordinary intelligence, with a little "seafaring education," to navigate a vessel to any port in the world; but it does not aim to supplant more comprehensive works on navigation. All complicated mathematical formulas are omitted, and also all calculations not readily and easily comprehended and performed. About one-half the volume is of necessity given to the tables of difference of latitude and departure; refraction, dip, and parallax; declination of the sun; equation of time; sines, tangents, and secants; etc.; without which no work of the kind is complete.

But, good as the book is, it has serious defects, which we hope to see remedied in later editions. These defects, however, while marring the literary value of the work, do not interfere with its value for the main purpose the author had in view. They arise from the attempt to condense into a few pages matter which, from its nature, does not readily lend itself to condensation. As a consequence, there are many sentences in the book which must be carefully studied, read over and over again, before the meaning is apparent. To the author, of course, familiar with the subject, all is clear; but to the student, to whom navigation may be "all Greek," the translation into plain English of puzzling obscurities, produced by ultra-condensation, may be a distasteful task. Then there are occasional lapses in grammar and in diction, which would not be so noticeable were they not in so noticeable a work. As a whole, the treatise is a good one, the need of such a work was felt, and we have no doubt that it will have a cordial reception.

A Century of Electricity. By T. C. MENDENHALL. Boston and New York, Houghton, Mifflin, & Co., 1890. 12°. $1.25.

THIS is a second edition, with additions, of this book, which was first published in 1886,—with additions, we note, as the progress of electrical science, which has been made mostly in the last hundred years, did not cease four years ago, but has made further strides Many of these advances have been in the applications of electricity to the production of light, and, in a broad way, to the transmission of power. Four years ago electrical appliances were popping up on every side, each putting forth a claim to great usefulness and to perfection. This activity in a new industrial field gave rise to the inevitable fever of speculation, which could but result in great disappointments, as the incompleteness of the novel inventions as they then stood was shown by experience. Then, again, the use of so powerful an agent in methods most crude led to disasters to human life and property, that aroused hostility to the new force. Our author traces all this matter of history, and shows how even the much talked of alternating currents have been gradually made more amenable to human wants, and records the general settling-down to really useful work of the electrical industries.

But it is on the side of theory also that enormous advances have been made recently in electrical science. Many know that a connection between electricity and light was suspected a dozen or twenty years ago by Clerk Maxwell. Now, in his additions, Professor Mendenhall records the experiments of Hertz, which show the suspicion of twenty years back to be true.

Many are interested in the display of electrical energy on every hand, and yet know little of how it has come to pass that there are electric cars, electric lights, electric printing-presses. For these Mendenhall's "Century of Electricity" is intended, and that they may rely upon it is shown by the fact that in two years only two errors have been pointed out in the text; and one of these dates back to Faraday himself, who overlooked a misstatement of one of the laws he discovered in his own publication of them,—an error which was inadvertently copied.

The Elements of Laboratory Work: A Course of Natural Science. By A. G. EARL. London and New York, Longmans. 12°.

THE author is a late scholar of Christ's College, Oxford, and now science master at Tonbridge School. The book is for use in laboratory work, and presupposes a fairly well stocked room for the instruction of beginners in physical science. The field of work is somewhat more limited than is frequently the case with books of this class, experiments on the physical and to some extent on the chemical properties of matter being made most prominent. Electrical measurements, which lend themselves admirably to higher laboratory work in physics, are but sparingly referred to. For ourselves, we do not approve of the minuteness with which the primary facts in regard to matter are supposed to be observed by the student using Earl's methods, but we are

aware that all teachers do not agree with us in this; but we do not hesitate in saying that to this, even now, new method of study "The Elements of Laboratory Work" is an addition, and that those who have such work in charge will find the experiments and exercises full of suggestions.

AMONG THE PUBLISHERS.

"HINTS on How to Travel" is the title of a handsomely illustrated little guide and information book just published by H. D. Newson & Co., 852 Broadway, this city.

—"The Growth of Yale Athletics," by Walter Camp, illustrated by instantaneous photographs taken on the campus; "Path of the Cyclone," seventeen views of the ruins in Louisville; "Mississippi Floods," breaks in the levees, river scenes, as pictured from the government vessel,—are published in *Illustrated American* No 9, for the week ending April 19.

—In the May number of the *New England Magazine* there will be a full-page portrait of George Kennan, which appears in connection with a poem on the recent Russian atrocities.

—"The Better Day" (New York, Funk & Wagnalls) is the title of the new periodical, the organ of the Better Day Reading Circles. It is a journal of temperance education, to extend the work begun by the course of scientific temperance instruction in the public schools.

—Encouraged by the success of the "Historiettes Modernes," by Professor C. Fontaine, Washington, D.C., the publishers, D. C. Heath & Co. (Boston) issued on the 21st a second volume by the same author, and edited on the same plan. The stories are short, pure, interesting, and of recent appearance in France, and the notes are full and suggestive.

—Two American honeysuckles which have often been confounded are admirably figured in last week's *Garden and Forest*. They are *Lonicera flava* and *Lonicera Sullivantii*, and the portraits will serve to facilitate their identification. Some sound advice about planting new places is given in the leading editorial article, and the great nurseries of the Messrs. Veitch & Sons, near London, are described. Besides the usual variety of seasonable horticultural matter, the number contains a review of Dr. Heinrich Mayr's important work on the forests of North America.

—Roberts Brothers have ready "London of To-Day," by Charles Eyre Pascoe, an illustrated handbook for the season of 1890.

—An article in *Lippincott's Monthly Magazine* for May of timely interest is "Subsidies and Shipping," by Henry W. Raymond. Mr. Raymond points out that all nations who are leaders in commerce grant subsidies to their shipping, and argues that in order to compete successfully with foreign nations we must adopt their methods.

—Charles Scribner's Sons have ready "The Wife of the First Consul," translated from the French of St. Amand by T. S. Perry, and have in press two more books by the same author,—"Marie Antoinette and the End of the Ancient Régime" and "The Happy Days of the Empress Louise." A revised edition has been prepared of Lafayette C. Loomis's "Index Guide to Travel and Art Study in Europe."

—Little, Brown, & Co. will publish next month "The Influence of Sea Power upon History," by Capt. A. T. Mahan, U.S.N., with twenty-five charts illustrative of great naval battles. The object of the work is an examination of the general history of Europe and America, and exemplification of the great determining influence of the maritime strength upon great issues,—a point which many historians have either overlooked or touched upon superficially. The period embraced is from 1660 to the end of the American Revolution.

—Messrs. Ginn & Co. announce for publication May 1, "Common School Music Charts," by W. S. Tilden, teacher of music in the State Normal School, Framingham, and author of "A Common School Song Reader." These charts are designed

Publications received at Editor's Office, April 14–19.

CANADA Geological and Natural History Survey. Plan of the Asbestus Areas in the Townships of Thetford, Coleraine, Wolfestown & Ireland. Ottawa, Geol. Surv. f°.
——Geological Map of the Province of New Brunswick. Ottawa, Geol. Surv. f°.
DAVIS, E. H. The Fourth Reading-Book. Philadelphia, Lippincott. 448 p. 12°. 80 cents.
HEROIC Ballads. With Poems of War and Patriotism. Ed. with notes by D. H. M. Boston, Ginn. 319 p. 12°. 50 cents.
MENDENHALL, T. C. A Century of Electricity. 2d ed. Boston and New York, Houghton, Mifflin, & Co. 243 p. 12°. $1.25.
SWEDENBORG, E. Angelic Wisdom concerning the Divine Love and the Divine Wisdom. New York, Amer. Swedenborg Publ. Co. 375 p. 24°.
U. S. COAST AND GEODETIC SURVEY. Annual Change of the Magnetic Declination for the Epoch January, 1890. Washington, Government. f°.
——Isogonic Chart of the United States for the Epoch 1890. Washington, Government. f°.
——Magnetic Meridians of the United States for January, 1890. Washington, Government. f°.
WARD, R. H. Plant Organization. 2d ed. Boston, Ginn. 31 p. 8°. 85 cents.

to furnish at moderate cost a brief course in note-reading for the smaller village and country schools, in which a full graded course cannot well be followed.

— Dr. Francis Warner (physician to the London Hospital, etc.) has prepared for publication his lectures on "The Growth of Intellectual Faculty," delivered for the Teachers' Training Syndicate, in Cambridge, during the Lent term in 1888 and 1889. The author insists on the necessity of observing physical facts, their causes and effects, when considering mental and moral questions, and has worked out a system of observing pupils in school. Special attention is given to such states as "attention," nervousness, sleep, fidgetiness, disobedience, lying, headache, low development, etc. Observations made in schools are largely referred to, and the notes of many cases are given. The book, which is illustrated with diagrams, will be issued shortly by Macmillan & Co.

—A year or two ago, a series of articles was published in *The Forum*, entitled "How I Was Educated." The contributors were presidents of universities and colleges, other prominent educators, and men of letters. These autobiographical papers were collected and printed in a separate volume, and now belong to the standard educational literature of the United States. A new series of articles will appear forthwith on an analogous question; viz., "What were the influences—the persons, the circumstances, the books—that have operated most to form the character and occupation of a number of notable scholars and men of letters and science?" The contributors to this series will include eight or ten of the foremost men of letters, men of science, teachers, and statesmen, American and foreign.

—Dr. E. N. Sneath, lecturer on the history of philosophy at Yale, has been inspiring the preparation of a series of small volumes of selections from the leading philosophers from Descartes down, so arranged as to present an outline of their systems. Each volume will contain a biographical sketch of the author, a statement of the historical position of the system, and a bibliography. Those so far arranged for are "Descartes," by Professor Ladd of Yale; "Spinoza," by Professor Fullerton of the University of Pennsylvania: "Locke," by Professor Russell of Williams; "Berkeley," by Ex-President Porter of Yale; "Hume," by Dr. Sneath of Yale; and "Hegel," by Professor Royce of Harvard. Kant, Comte, and Spencer will certainly be added to the series, and others if encouragement is received. The publishers will be Henry Holt & Co.

— Mr. D. C. Thomson, author of "The Life and Works of Thomas Bewick" and "The Life of H. K. Browne, 'Phiz,'" has had in preparation for the past three years an important work on the Barbizon School of Painters. This volume will be similar in size (quarto) and character to the "Life of Bewick" and the "Life of 'Phiz,'" and will be illustrated with numerous plates and wood-engravings. The work will supply a complete biographical and critical account of the group of five celebrated French painters known as the Barbizon School, —Theodore Rousseau, Jean François Millet, Narcisse Virgilio Diaz, Charles François D'Aubigny, and Jean Baptiste Camille Corot. Such a publication necessarily demands excellent illustrations; and many representations will be given of pictures, drawings, and portraits, in various methods of reproduction, — etching, photogravure, wood-engraving, etc. It is proposed to publish the volume by subscription, which should be forwarded to Scribner & Welford, New York, without delay.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Psychrometer.

THERE have recently appeared two quite extended investigations on the use of the psychrometer (wet and dry bulb thermometers) in determining the moisture-contents of the air. The first is a comparison with the condensing hygrometer, made by Professor S. A. Hill of Allahabad, India, published in the *Journal of the Asiatic Society of Bengal* (vol. vii., 1888). Recent investigations in this country have shown the entire uselessness of trying to obtain refined results with an unventilated psychrometer, and we note that a partial neglect of this precaution has led to wrong inferences in this paper. The experiments with the Regnault apparatus revealed the same difficulties, with the plate, fumes of ether, etc., that have been noted by others. The comparisons were made with artificial ventilation, as well as in a breeze and in still air, at pressures ranging from 20.6 to 29.4 inches. There were twenty-seven observations; and of these, four had an artificial ventilation. The method of ventilation is not given, but we may assume that it was sufficient to give good readings. The following are the results:—

Pressure.	Dry Bulb.	Wet Bulb.	Dew Point.	
			Regnault.	Hazen Table.
23.55	71.4	49.5	19.9	19.5
23.50	60.3	52.1	45.7	45.0
25.80	86.8	62.1	43.6	43.8
23.51	69.3	59.6	52.6	52.7

The results given in the last two columns are most extraordinary. There is almost a perfect accordance between the dew-point observed at heights up to 6,500 feet and that computed for a height of 600 feet from the ventilated psychrometer. Without more information as to the accuracy of the condensing hygrometer and the sufficiency of the ventilation, it would be dangerous to argue upon these results; but the coincidence between them and those obtained in this country by the writer up to 3,000 feet is very remarkable. Professor Hill, by combining together all the ventilated and unventilated readings, obtains an exactly opposite result, but it is now known that unventilated psychrometer readings are worthless for careful comparison.

The second paper is by Dr. Haldane and M. S. Pembrey of Oxford, England. It is to be found in the *Philosophical Magazine*, April, 1890, pp. 306–331. In this paper an attempt is made to compare the unventilated psychrometer with determinations of moisture by chemical methods. The experimenters have given the chemical method an exhaustive study, and their results in that line are excellent. The comparisons with the psychrometer, twelve in number, are unsatisfactory and lead to erroneous conclusions for the reason already given. Five out of the total were made in so damp an air that they cannot help in the comparison. The other seven are as follows:—

		Vapor Pressure in Millimetres Computed.						
Dry.	Wet.	Observed Chemical.	Glaisher.	Regnault.	Hazen.	Gl., H. & P.	(6) — (3)	(7) — (3)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
61.6	53.0	7.43	8.58	7.37	7.57	7.76	.14	.33
61.3	54.9	8.99	9.65	8.84	9.14	9.00	.15	.01
63.7	56.0	8.78	9.63	8.79	9.14	8.99	.36	.21
61.5	53.0	7.63	8.58	7.37	7.87	7.78	.24	.15
63.0	55.2	8.90	9.40	8.46	8.97	8.68	.07	—.22
64.1	57.0	10.00	10.18	9.45	9.83	9.52	—.17	—.48
64.6	57.4	10.23	10.49	9.60	10.03	9.67	—.20	—.56
Mean.....		8.85	9.50	8.55	8.94	8.77	.09	—.08

In column (4) are given vapor pressures computed by Glaisher's Tables, as published in Guyot's Tables, 1884. It is very gratify-

ing to note that these have been materially modified recently, as shown by column (7). Formerly they were exceedingly unsatisfactory. It will be seen that the most satisfactory argument lies in columns (3) and (6); but since column (6) is for a ventilated psychrometer, and the readings used were unventilated, we must conclude that the chemical method for obtaining vapor pressure, as given by this investigation, does not agree with the condensing hygrometer. It is much to be regretted that comparisons were not instituted between the chemical method, the sling psychrometer, and the condensing hygrometer. This paper is a valuable addition to our knowledge of chemical methods, and narrows down the remaining unexplored field of research for measuring the moisture of the air.

H A. HAZEN.

Washington, April 16.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

A large number of plants from Maine, Connecticut, Indiana and Illinois for exchange. Southern and western exchanges preferred. Address, enclosing lists, L. N. Johnson, 223 Chicago Ave., Evanston, Ill.

For Exchange—Fourteen volumes Encyclopedia Britannica (Stoddard's ninth edition), bound in leather—part in original wrappers, all as new—can arrange to furnish volumes required to complete set, and six volumes "American Naturalist" in numbers. Want small screw-cutting foot lathe and testing galvanometer and rheostat. For particulars address A. B. Campbell, McKean Co., Bradford, Pa.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.

Correspondence and exchanges solicited with persons interested in the study of American and Mexican antiquities. L. W. Gunckel, 36 Elm St., New Haven, Conn.

Wanted—Books and journals, American or foreign, relating to Photography—exchange or purchase. C. W. Canfield, 1,321 Broadway, New York.

Wanted.—Marine univalves of the west coast, from U. S. line southward, and from Pacific Islands, offered; exchange from a general collection. — F. C. Browne, Framingham, Mass., Box 50.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

AN EXPERIENCED Technical Chemist will be open to engagement this summer. Highest references. Address DIRECTOR, Office of SCIENCE.

ELECTRICITY.—A young man with a knowledge of electricity and a taste for journalism can learn of an opening by addressing SCIENCE, 47 Lafayette Place, New York.

PROF. WILLIAM FINDLAY, of the Philadelphia Institute of Physical Culture, is open to engagement in summer school to teach Free Movements, Wands, Clubs, Dumb-bells, Fencing and Sparring. Address 1,009 Arch St., Phila., Pa.

WANTED.—A position in an Academy, Normal or High School, as teacher of the Natural Sciences and Modern Languages. Latin taught in addition if necessary. Address G., Box 144, Hanover, N. H.

WANTED—One or two persons with some means interested in Archæology to accompany a reliable antiquarian to Southern Ohio for four months' work in the mounds. The specimens found to be shared equally. For terms address W. K. M., Box 148, Smithsonian Institute, Washington, D. C.

WANTED—Position to teach Sciences or Mathematics by a Smith College graduate who was also a student at the Mass. Institute of Technology. Nine years' experience. Address T. H., care of SCIENCE.

A YOUNG LADY, graduate of Boston University, also of special course at the Massachusetts Institute of Technology, desires a position to teach Chemistry, Physics and Mathematics. Two years' experience. References given. Address Miss B. L., Warren, Mass.

A YOUNG MAN aged 19, a graduate of Eastman College, wants to serve an apprenticeship with some Manufacturing Electrical Laboratory where he can have access to books in evening. Is willing to work. The best of references given. C. F. BENEDICT, P. O. Box 84, Westbury, Wayne Co., N.Y.

AN experienced College Professor, with considerable ability in advertising educational institutions, now employed, is open to an engagement. Has built up two schools by advertising. Now is just the time to begin work for September opening. "William," 348 East 20th St., New York.

WANTED by a Cornell University graduate a position as Chemist in some Manufacturing establishment. References given. T. B.

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CALENDAR OF SOCIETIES.

Anthropological Society, Washington.

April 15.—S. V. Proudfit, A Collection of Stone Implements from the District of Columbia; Romyn Hitchcock, Among the Ainos of Yezo (illustrated with lantern).

American Folk-Lore Society, Boston.

April 18.—J. Walter Fewkes, Phonograph in the Preservation of the Folk-Lore of the American Indians; Passamaquoddy songs, tales, legends and conversations, were repeated by the phonograph.